

REMARKS

Applicants respectfully request reconsideration of the present application in view of the reasons that follow. A detailed listing of all claims that are, or were, in the application, irrespective of whether the claim(s) remain under examination in the application, is presented, with an appropriate defined status identifier.

I. Introduction

Claims 1-49 and 67 are pending in this application. Claims 50-66 are cancelled without prejudice or disclaimer. Applicants respectfully request that dependent claims 5-12 and 16-23 be rejoined with independent claims 1 and 13, respectively, upon allowance of claims 1 and 13. Further, Applicants respectfully request that claims 24-36 and 37-49 be rejoined with independent claims 1 and 13, respectively, upon allowance of claims 1 and 13.

II. The Rejections Should be Withdrawn

Claims 1-4, 13-15 and 67 are rejected under § 103(a) as being obvious over Hantschel (U.S. Patent Application Publication No. 2002/0040884) in view of Empedocles (U.S. Patent Application Publication No. 2004/0005723). These rejections are respectfully traversed.

A. No teaching or suggestion of a nanowhisker grown on a tip member

Claims 1 and 13 both recite, “the nanowhisker is grown on a free end of the tip member.” Neither Hantschel nor Empedocles, alone or in combination, teach or suggest this claim limitation. Thus, Hantschel and Empedocles cannot render obvious claims 1 and 13 because “[t]o establish prima facie obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art.” MPEP § 2143.03 (citing *In re Royka*, 490 F.2d 981, 180 USPQ 580 (CCPA 1974)) (emphasis added). Therefore, the rejections should be withdrawn.

Although Hantschel teaches diamond tips on a cantilever beam, Hantschel fails to teach or suggest a nanowhisker that is grown on a tip member. Rather than growing nanowhiskers, Hantschel etches a layer of material to leave at least one tip protruding from

the surface, as shown in the process sequence of Figure 5 in Hantschel. Etching is not growing. Indeed, page 2 of the Office Action uses the word “terminated” rather than “grown” to describe the tips 4, 5, 11 and 28 in Figures 1-4 and 7-8 of Hantschel. Thus, Hantschel does not teach or suggest nanowhisker growth on a tip member.

Empedocles teaches nanowire growth, but fails to teach or suggest nanowhisker growth on a free end of a tip member. Figure 9 of Empedocles shows a flat (silicon wafer) substrate 904 that is coated with a catalyst 901. Nowhere does Empedocles teach or suggest that the flat substrate 904 can be substituted for a tip member, such as the conical tip member 4 in Figure 1a of the present application. Paragraph [0007] of Empedocles suggests varying the “substrate material” and the “nature of the substrate” (emphases added), but does not suggest varying the three-dimensional shape of the substrate (i.e., using a tip member as the substrate). Therefore, Empedocles does not teach or suggest nanowhisker growth on a tip member.

Because Hantschel and Empedocles fail to teach or suggest nanowhiskers grown on a tip member, the cited references fail to teach or suggest “all the claim limitations” as required for an obviousness rejection under MPEP § 2143.03 (citing *In re Royka*, 490 F.2d 981, 180 USPQ 580 (CCPA 1974)).

B. No motivation to combine Empedocles’ heterojunction or metal catalyst particle with Hantschel’s cantilever

Even if the cited references teach or suggest all the claim limitations, the obviousness rejections should be withdrawn because “there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings.” MPEP § 2143 (citing *In re Vaack*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991)). “The teaching or suggest to make the claimed combination . . . must . . . be found in the prior art, not in the applicant’s disclosure.” *Id.* In the instant case, a person skilled in the art would not have combined the heterojunction or metal catalyst particle of Empedocles with the cantilever of Hantschel to achieve the claimed invention. Therefore, Empedocles and Hantschel cannot render obvious either claim 1 (reciting “a nanowhisker comprising a heterojunction” in a structure “for a

scanning probe microscope”) or claim 13 (reciting “a nanowhisker containing a metal catalyst particle” and “a flexible support member”).

1. Claim 1

Claim 1 recites “a nanowhisker comprising a heterojunction” in a nanotechnological structure “for a scanning probe microscope.” None of the references suggest the desirability of using a heterojunction nanowhisker for scanning probe microscopy (SPM). It is not at all clear from the references why a person having ordinary skill in the art would have altered Hantschel’s SPM configuration, which Hantschel in paragraph [0028] admits is a “special tip arrangement [that] allows the adjustment of a maximum penetration depth into the sample” and that is “especially suited as a nano-SRP (nano-Spreading Resistance) probe.” (emphases added). By replacing Hantschel’s “special tip arrangement” with Empedocles’ heterojunction nanowire, the Office Action’s proffered modification threatens to impermissibly “change the principle of operation of the prior art invention being modified.” MPEP. § 2143.01. Indeed, absent any teaching or suggestion of how a person skilled in the art would have realistically modified these references, simply replacing Hantschel’s “special tip arrangement” would have risked changing Hantschel’s principle of operation (i.e., use as a nano-SRP probe).

Empedocles does not teach or suggest the desirability of using heterojunction nanowhisker for SPM. The text of Empedocles contains no mention of the words “cantilever” or “flex.” The only mention of “scanning probe microscopy” is in the title of a cited reference in paragraph [0243] of Empedocles (citing Manalis et al., (2000) “Microvolume Field-Effect pH Sensor for the Scanning Probe Microscope” Applied Phys. Lett. 76, 1072-1074). Likewise, the only mention of “atomic force microscope” is in the title of a cited reference in paragraph [0230] of Empedocles (citing Lieber et al. (1993) “Machining Oxide Thin Films with an Atomic Force Microscope: Pattern and Object Formation on the Nanometer Scale” U.S. Pat. No. 5,252,835). However, these two citations are not a teaching or suggestion to achieve the claimed invention because merely citing a laundry list of references, as Empedocles has done, does not sufficiently enable or show the desirability of using a heterojunction nanowhisker for SPM.

In contrast, the present inventors have discovered the desirability of using a heterojunction nanowhiskey for SPM. As a non-limiting example, a heterojunction nanowhiskey provides "a very narrow energy distribution of injected carries" for studying sample surfaces, as described in the first full paragraph of page 6 of the present application. Neither Hantschel nor Empedocles, alone or in combination, provide such a teaching or suggestion for using a heterojunction nanowhiskey for SPM. Therefore, Hantschel and Empedocles do not render obvious claim 1. The rejected dependent claims are considered to be allowable over Hantschel and Empedocles for at least the same reasons.

Page 3 of the Office Action refers to paragraphs [0002], [0030], and [0086] of Empedocles in support of the assertion that "[i]t would have been obvious . . . to use a heterojunction in the nanowhiskey in order to form functional elements from the nanowhiskey, such as a transistor, or to provide selectively etchable portions . . . thereby increasing the device functionality."

However, there is no motivation to form a transistor with a heterojunction in the device of Hantschel or to use selectively etchable portions of a nanowhiskey heterojunction in the device of Hantschel.

Furthermore, formation of a heterojunction containing transistor or selective etching of a nanowhiskey heterojunction are not part of the claimed invention. None of the cited paragraphs of Empedocles teach or suggest a heterojunction nanowhiskey in a structure for a scanning probe microscope (SPM). For example, paragraph [0002] merely states that the invention relates to "the field of nanostructure . . . manufacture and assembly." Paragraph [0030] refers to selectively etching the different materials contained in the heterojunction, but suggests nothing about its use in SPM. Finally, paragraph [0086] lists a variety of applications for nanowires ("junctions, transistors, field effect transistors, amplifiers, circuits, diodes, gates, emitters, collectors, p-type gates, sensors, memory, or the like, or can be simple arrays of nanowires"). Importantly, none of the devices listed is a cantilever or beam member for SPM or, for that matter, any mechanically-active device.

2. Claim 13

Claim 13 recites both “a nanowhisker containing a metal catalyst particle” and “a flexible support member.” None of the references suggest the desirability of using a nanowhisker containing a metal catalyst together with a flexible support member.

For at least the same reasons as discussed with regard to the nonobviousness of claim 1, it is not at all clear from the references why a person having ordinary skill in the art would have altered Hantschel’s “special tip arrangement” in order to achieve a nanowhisker containing a metal catalyst. To do so at the time of the invention, when armed only with the teachings of the cited references, would have risked changing Hantschel’s principle of operation (i.e., use as a nano-SRP probe) and unduly complicated Hantschel’s fabrication process.

There is no motivation to complicate the process of Hantschel which forms the tip arrangement by simply etching a layer of material by instead using the process of Empedocles which would requires precise positioning of a catalyst particle on a small tip member of Hantschel and then a separate nanowhisker growth from the catalyst particle.

Furthermore, for at least the same reasons as discussed in the previous section with regard to Empedocles’ lack of teaching or suggestion, Empedocles is silent as to the desirability of using a nanowhisker containing a metal catalyst together with a flexible support member. The text of Empedocles contains no mention of the words “cantilever” or “flex” or “bend.” Figure 9 of Empedocles shows a silicon wafer substrate 904 that is coated with a catalyst 901. Nowhere does Empedocles teach or suggest that the silicon wafer substrate 904, which is known in the art to be a rigid wafer, can be substituted for a flexible support member, as recited in claim 13.

Page 3 of the Office Action refers to paragraphs [0044], [0093], and [0096] of Empedocles in support of the assertion that “[i]t would have been obvious . . . to include a catalyst in the nanowhisker in order to pre-pattern and seek the growth of the nanowhisker.” However, as noted above, Hantschel’s nanowhiskers are not grown. Instead, they are etched from a layer. Therefore, one of ordinary skill in the art would not use a catalyst particle to

form the nanowhiskers of Hantschel because the nanowhiskers of Hantschel are not grown. None of the cited paragraphs teach or suggest both a flexible support member and a nanowhisker containing a metal catalyst particle. Paragraph [0044] describes methods of seeding growth on a templated substrate; paragraph [093] describes patterning catalyst droplets in specific locations on the substrate; and paragraph [0096] describes different catalyst compositions and shapes. However, none of these cited paragraphs teaches or suggests both a flexible support member and a nanowhisker containing a metal catalyst particle, as required by claim 13.

Therefore, Applicants respectfully request withdrawal of the rejection of claim 13. The dependent claims are believed allowable for at least the same reasons.

III. Conclusion

Applicants believe that the present application is now in condition for allowance. Favorable reconsideration of the application as amended is respectfully requested. The Examiner is invited to contact the undersigned by telephone if it is felt that a telephone interview would advance the prosecution of the present application.

The Commissioner is hereby authorized to charge any additional fees which may be required regarding this application under 37 C.F.R. §§ 1.16-1.17, or credit any overpayment, to Deposit Account No. 19-0741. Should no proper payment be enclosed herewith, as by a check or credit card payment form being in the wrong amount, unsigned, post-dated, otherwise improper or informal or even entirely missing, the Commissioner is authorized to charge the unpaid amount to Deposit Account No. 19-0741. If any extensions of time are needed for timely acceptance of papers submitted herewith, Applicants hereby petition for such extension under 37 C.F.R. §1.136 and authorizes payment of any such extensions fees to Deposit Account No. 19-0741.

Respectfully submitted,

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